

Amendments to the Specification

Please replace the paragraph beginning at line 1, page 2 with the following paragraph:

B1  
--The three layers are normally extruded onto the conductor at a low temperature (below 135°C) in order to prevent the crosslinking reactions from taking place during the extrusion process. After the extrusion step the construction is crosslinked in a pressurized vulcanizing tube at an elevated temperature.--

Please replace the paragraph beginning at line 7, page 2 with the following paragraph:

--LDPE (low density polyethylene), i.e. polyethylene prepared by radical polymerization at a high pressure and crosslinked by adding a peroxide in connection with the extrusion of the cable, is today the predominant cable insulating material. Radical polymerization results in long chain branched polymers having a relatively broad molecular weight distribution (MWD). This in turn results in desirable rheological properties with regard to their application as insulating materials for electric power cables.--

Please replace the paragraph beginning at line 17, page 2 with the following paragraph:

-- A limitation with LDPE lies in the fact that it is made by radical polymerization. Radical polymerization of ethylene is carried out at high temperatures of up to about 300°C and at high pressures of about 100-300 MPa. To generate the high pressures needed energy consuming compressors are required. Considerable investment costs are also required for the polymerization apparatus which must be able to resist the high pressures and temperatures of radical initiated high pressure polymerization.--

Please replace the paragraph beginning at line 26, page 2 with the following paragraph:

B2  
-- With regard to insulating compositions for electric power cables it would be desirable both from a technical and an economical point of view if it was were possible to make an ethylene polymer with the advantageous properties of LDPE, but which was not made by radical polymerization. This would mean that insulation for electric cables could be made not only at plants for high pressure polymerization of ethylene, but also at the many existing plants for low pressure polymerization of ethylene. In order to be a

satisfactory replacement for LDPE such a low pressure material would have to fulfill a number of requirements for insulating materials, such as good processability, high dielectric strength and good crosslinking properties. It has turned out, though, that for various reasons existing low pressure materials are not suitable as replacement for LDPE as insulating material for electric cables.--

B2  
cont

[ Please replace the paragraph beginning at line 6, page 3 with the following paragraph: ]

-- Thus, conventional high density polyethylene (HDPE) produced by polymerization with a coordination catalyst of Ziegler-Natta type at low pressure has a melting point of about 130-135°C. When a HDPE is processed in an extruder the temperature should lie above the melting point of 130-135°C to achieve good processing. This temperature lies above the decomposition temperature of the peroxides used for the crosslinking of insulating ethylene polymer compositions. Dicumyl peroxide e.g. which is the most frequently used crosslinking peroxide starts to decompose at a temperature of about 135°C. Therefore, when HDPE is processed above its melting temperature in an extruder the crosslinking peroxide decomposes and prematurely crosslinks the polymer composition, a phenomenon referred to as "scorching". If, on the other hand the temperature is kept below the decomposition temperature of the peroxide then the HDPE will not melt adequately and unsatisfactorily processing will result.--

[ Please replace the paragraph beginning at line 24, page 3 with the following paragraph: ]

-- Further, ethylene copolymers made by polymerization with a coordination catalyst at low pressure, like linear low density polyethylene (LLDPE) are unsuitable due to poor processability. The processability may be improved by polymerizing the LLDPE in two or more steps (bimodal or multimodal LLDPE), but such LLDPE includes high melting HDPE fractions or components, particularly when the polymerization is carried out with conventional Ziegler-Natta catalysts, which makes LLDPE unsuitable for the same reason as conventional HDPE.--

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Please replace the paragraph beginning at line 33, page 4 with the following paragraph:

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-- In view of the above it would be an advantage if it was possible to replace crosslinkable LDPE made by radical initiated polymerization as a material for the insulating layer of electric power cables by an ethylene polymer made by coordination

B3 Cont  
catalysed low pressure polymerization. Such a replacement polymer should have rheological properties, including processability similar to those of LDPE. Further, it should have a low enough melting temperature to be completely melted at 125°C in order to avoid "scorch" due to premature decomposition of the crosslinking peroxide.--

Please replace the paragraph beginning at line 8, page 5 with the following paragraph:

-- It has now been discovered that LDPE may be replaced as a crosslinkable material for the insulation layer of electric cables by a crosslinkable ethylene copolymer made by coordination catalysed low pressure polymerization which ethylene copolymer is a multimodal ethylene copolymer with specified density and viscosity and with melting temperature of at most 125°C.--

B4 [ Please replace the paragraph beginning at line 15, page 5 with the following ]  
paragraph:

-- More particularly the present invention provides an insulating composition for an electric power cable which comprises a crosslinkable ethylene polymer, characterized in that the ethylene polymer is a multimodal ethylene copolymer obtained by coordination catalysed polymerization of ethylene and at least one other alpha-olefin in at least one stage, said multimodal ethylene copolymer having a density of 0.890-0.940 g/cm<sup>3</sup>, a MFR<sub>2</sub> of 0.1-10 g/10 min a MWD of 3.5-8, a melting temperature of at most 125°C and a comonomer distribution as measured by TREF, such that the fraction of copolymer eluted at a temperature higher than 90°C does not exceed 10% by weight, and said multimodal ethylene copolymer including an ethylene copolymer fraction selected from (a) a low molecular weight ethylene copolymer having a density of 0.900-0.950 g/cm<sup>3</sup> and a MFR<sub>2</sub> of 25-500 g/10 min, and (b) a high molecular weight ethylene copolymer having a density of 0.870-0.940 g/cm<sup>3</sup> and a MFR<sub>2</sub> of 0.01-3 g/10 min.--

Please replace the paragraph beginning at line 12, page 6 with the following paragraph:

B5 -- The present invention also provides an electric power cable comprising a conductor surrounded by an inner semiconducting layer, an insulating layer, and an outer semiconducting layer, characterized in that the insulating layer comprises a crosslinked ethylene copolymer obtained by coordination catalysed polymerization of ethylene and at least one other alpha-olefin in at least one stage, said multimodal ethylene copolymer having a density of 0.890-0.940 g/cm<sup>3</sup>, a MFR<sub>2</sub> of 0.1-10 g/10 min, a MWD of 3.5-8, a

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melting temperature of at most 125°C and a comonomer distribution as measured by TREF such that the fraction of copolymer eluted at a temperature higher than 90°C does not exceed 10% by weight, and said multimodal ethylene copolymer including an ethylene copolymer fraction selected from (a) a low molecular weight ethylene copolymer having a density of 0.900-0.950 g/cm<sup>3</sup> and a MFR<sub>2</sub> of 25-500 g/10 min, and (b) a high molecular weight ethylene copolymer having a density of 0.870-0.940 g/cm<sup>3</sup> and a MFR<sub>2</sub> of 0.01-3 g/10 min.--

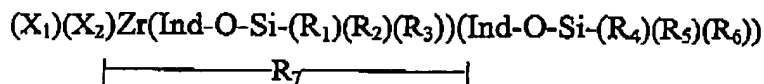
Please replace the paragraph beginning at line 32, page 7 with the following paragraph:

-- It is previously known to produce multimodal, in particular bimodal, olefin polymers, preferably multimodal ethylene plastics, in two or more reactors connected in series. As instances of this prior art, mention may be made of EP 040 992, EP 041 796, EP 022 376 and WO 92/12182, which are hereby incorporated by way of reference as regards the production of multimodal polymers. According to these references, each and every one of the polymerization stages can be carried out in liquid phase, slurry or gas phase.--

B6

Please replace the paragraph beginning at line 5, page 8 with the following paragraph:

-- The catalyst used to produce the composition is a supported single site catalyst. The catalyst should produce a relatively narrow molecular weight distribution and comonomer distribution in one stage polymerization. Also, the catalyst should be able to produce a high enough molecular weight so that good mechanical properties are obtained. It is known that some metallocene catalysts are able to produce a high enough molecular weight. Examples of such catalysts are e.g. those based on siloxy-substituted bridged bis-indenyl zirconium dihalides, as disclosed in the Finnish patent application FI 960437 which have the general formula:



where

X<sub>1</sub> and X<sub>2</sub> are either same or different and are selected from a group containing halogen, methyl, benzyl and hydrogen,

Zr is zirconium,

Ind is an indenyl group,

B6  
cont

$R_1$  to  $R_6$  are either the same or different and are selected from a group containing linear and branched hydrocarbyl groups containing 1-10 carbon atoms and hydrogen,

$R_7$  is a linear hydrocarbyl group containing 1-10 carbon atoms,

Si is silicon, and

O is oxygen;

or on n-butyl dicyclopentadienyl hafnium compounds disclosed in FI-A-934917 which have the general formula:



where

$X_1$  and  $X_2$  are either same or different and are selected from a group containing halogen, methyl, benzyl or hydrogen,

Hf is hafnium

Cp i cyclopentadienyl group, and

$R_1$  and  $R_2$  are either the same or different and are either linear or branched hydrocarbyl groups containing 1-10 carbon atoms.--

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Please replace the paragraph beginning at line 27, page 9 with the following paragraph:

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-- According to the present invention, the main polymerization stages are preferably carried out as a combination of slurry polymerization/gas-phase polymerization or gas-phase polymerization/gas-phase polymerization. The slurry polymerization is preferably performed in a so-called loop reactor. The use of slurry polymerization in a stirred-tank reactor is not preferred in the present invention, since such a method is not sufficiently flexible for the production of the inventive composition and involves solubility problems. In order to produce the inventive composition, a flexible method is required. For this reason, it is preferred that the composition is produced in two main polymerization stages in a combination of loop reactor/gas-phase reactor or gas-phase reactor/gas-phase reactor. It is especially preferred that the composition is produced in two main polymerization stages, in which case the first stage is performed as slurry polymerization in a loop reactor and the second stage is performed as gas-phase polymerization in a gas-phase reactor. Optionally, the main polymerization stages may be preceded by a prepolymerization, in which case up to 20% by weight, preferably 1-10% by weight, of the total amount of polymers is produced. Generally, this technique results in a multimodal polymer through polymerization with the aid of a single site catalyst such as a metallocene catalyst in several successive polymerization reactors.--

[ Please replace the paragraph beginning at line 17, page 10 with the following paragraph: ]

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Cont

-- Alternatively, a multimodal polymer may be produced through polymerization in one single polymerization reactor with the aid of a dual site coordination catalyst or a blend of different coordination catalysts. The dual site catalyst may comprise two or more different single site or metallocene species, each one of which produces a narrow molecular weight distribution and a narrow comonomer distribution. If a blend of catalysts is used, they need to be of a single site type of catalysts, such as metallocene catalysts. It is preferred, though, that the polymerization be carried out in two or more polymerization reactors connected in series.--

[ Please replace the paragraph beginning at line 29, page 10 with the following paragraph: ]

-- In the production of a bimodal ethylene copolymer, a first ethylene copolymer fraction is produced in a first reactor under certain conditions with respect to monomer composition, hydrogen-gas pressure, temperature, pressure, and so forth. After the polymerization in the first reactor, the reaction mixture including the copolymer fraction produced is fed to a second reactor, where further polymerization takes place under other conditions. Usually, a first copolymer fraction of high melt flow rate (low molecular weight) and with an addition of comonomer, is produced in the first reactor, whereas a second copolymer fraction of low melt flow rate (high molecular weight) and with an addition of comonomer is produced in the second reactor. As comonomer, use is preferably made of  $\alpha$ -olefins having up to 8 carbon atoms, such as propene, 1-butene, 4-methyl-1-pentene, 1-hexene, and 1-octene. The resulting end product consists of an intimate mixture of the copolymers from the two reactors, the different molecular-weight-distribution curves of these copolymers together forming a molecular-weight-distribution curve having one broad maximum or two maxima, i.e. the end product is a bimodal polymer mixture. Since multimodal, and especially bimodal polymers, and the production thereof belong to the prior art, no further detailed description is called for here, but reference is made to the above specifications.--

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Please replace the paragraph beginning at line 34, page 11 with the following paragraph:

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-- As hinted above, it is preferred that the multimodal olefin copolymer in the cable-insulating composition according to the invention is a bimodal ethylene copolymer. It is also preferred that this bimodal ethylene copolymer has been produced by

B8  
cont

polymerization as above under different polymerization conditions in two or more polymerization reactors connected in series. Owing to the flexibility with respect to reaction conditions thus obtained, it is preferred that the polymerization is carried out in a loop reactor/a gas-phase reactor, a gas-phase reactor/a gas-phase reactor or a loop reactor/a loop reactor. The polymerization conditions in the preferred two-stage method are so chosen that a comparatively low molecular weight ethylene copolymer is produced in one stage, preferably the first stage, owing to a high content of chain-transfer agent (hydrogen gas), whereas a high molecular weight ethylene copolymer is produced in another stage, preferably the second stage. The order of these stages may, however, be reversed.--

Please replace the paragraph beginning at line 15, page 14 with the following paragraph:

-- Although the multimodal ethylene copolymer of the invention could in principle consist of a polymerized blend of any number of ethylene copolymer fractions, it is preferred that it consists of two ethylene copolymer fractions only, namely a low molecular weight (LMW) ethylene copolymer fraction and a high(er) molecular weight (HMW) ethylene copolymer fraction.--

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[ Please replace the paragraph beginning at line 22, page 14 with the following paragraph: ]

-- The preferred multimodal ethylene copolymer of the invention is thus obtained by a two-stage polymerization process, where a LMW ethylene copolymer fraction is produced in the first polymerization stage and a HMW ethylene copolymer fraction is produced in the second polymerization stage. Preferably for use in non-flexible power supply cable, the LMW ethylene copolymer fraction has a density of 0.925-0.940 g/cm<sup>3</sup>, and a MFR<sub>2</sub> of 25-300, preferably 40-200, more preferably 50-100 g/10 min. For use in flexible applications the density should preferably lie in the range 0.900-0.925 g/cm<sup>3</sup>. The comonomer content of the LMW ethylene copolymer fraction is preferably 3-15 % by weight. The HMW ethylene copolymer fraction has such a density, comonomer content, and MFR that the multimodal ethylene copolymer obtains the values of density/comonomer content, viscosity/melt flow rate, MWD and melting temperature specified above.--

Please replace the paragraph beginning at line 6, page 15 with the following paragraph:

B10

-- More particularly, a calculation indicates that when the LMW ethylene copolymer has the above specified values, the HMW ethylene copolymer produced in the second polymerization stage of a two-stage process should have a density of 0.870-0.910 g/cm<sup>3</sup> for flexible cable and of 0.910-0.940 g/cm<sup>3</sup> for non-flexible cable, and a MFR<sub>2</sub> of 0.01-3, preferably 0.1-2.0 g/10 min. Preferably the comonomer content is 20-15 % by weight in flexible compositions and 18-2 % by weight in non-flexible ones.--

[ Please replace the paragraph beginning at line 15, page 15 with the following paragraph: ]

-- As stated in the foregoing, the order of the polymerization stages may be reversed, which would mean that, if the multimodal ethylene copolymer has a density and a viscosity as defined above, and the HMW ethylene copolymer produced in the first polymerization stage has a density of 0.910-0.940 g/cm<sup>3</sup> for non-flexible applications and 0.870-0.910 g/cm<sup>3</sup> for flexible ones, and a MFR<sub>2</sub> of 0.01-3 g/10 min, then the LMW ethylene copolymer produced in the second polymerization stage of a two-stage process should, according to calculations as above, have a density of 0.920-0.950 g/cm<sup>3</sup> for non-flexible compositions and of 0.900-0.930 g/cm<sup>3</sup> for flexible ones, and a MFR<sub>2</sub> of 25-300 g/10 min. This order of the stages in the production of the multimodal ethylene copolymer according to the invention is, however, less preferred.-

Please replace the paragraph beginning at line 6, page 21 with the following paragraph:

-- Comparative Example 1

B11

For the polymerization of ethylene a loop reactor and a gas-phase reactor connected in series were used together with a prepolymerization reactor (Pre PR). In addition to ethylene 1-butene was used as a comonomer in the loop reactor and the gas-phase reactor. Hydrogen was used as a modifier. The catalyst was a catalyst of Ziegler-Natta type and was added to the prepolymerization reactor. Propane was used as a reaction medium in the loop reactor. The gaseous components of the product from the loop reactor were removed in a flash tank, whereafter the product was transferred to the gas-phase reactor where the polymerization was continued. The polymerization conditions and the product properties are shown in Table 3.--

Please replace the abstract with the following:



B11  
-- An insulating composition for an electric power cable, and an electric power cable comprising a conductor surrounded by an inner semiconducting layer, an insulating layer, and an outer semiconducting layer, where the insulating layer consists of said the insulating composition, are disclosed. The insulating composition is characterized in that the ethylene polymer is a multimodal ethylene copolymer obtained by coordination catalyzed polymerization of ethylene and at least one other alpha-olefin in at least one stage, said the multimodal ethylene copolymer having a density of 0.890-0.940 g/cm<sup>3</sup>, a MFR<sub>2</sub> of 0.1-10 g/10 min, a MWD of 3.5-8, a melting temperature of at most 125°C, and a comonomer distribution as measured by TREF, such that the fraction of copolymer eluted at a temperature higher than 90°C does not exceed 10% by weight, and said the multimodal ethylene copolymer including an ethylene copolymer fraction selected from (a) a low molecular weight ethylene copolymer having a density of 0.900-0.950 g/cm<sup>3</sup> and a MFR<sub>2</sub> of 25-500 g/10 min, and (b) a high molecular weight ethylene copolymer having a density of 0.870-0.940 g/cm<sup>3</sup> and a MFR<sub>2</sub> of 0.01-3 g/10 min.--